

IN-SITU GRAPHENE OXIDE THERMAL ANALYSES VIA TEM/EELS: WATER DESORPTION, REDUCTION AND GRAPHITISATION

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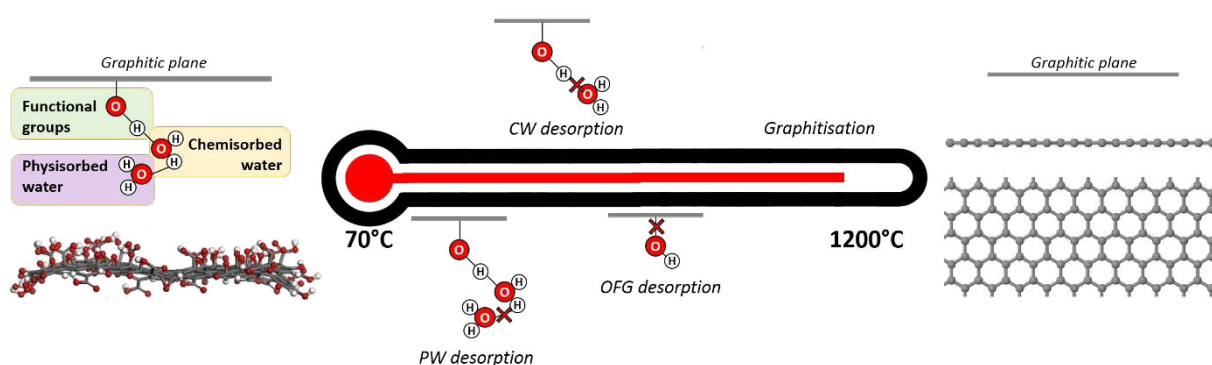
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For the last fifteen years, graphene oxide (GO) has become a material of great importance within the subject of chemically modified graphene (CDG)[1] for its vast potential applications[2]. However, both the chemical structure of Graphene oxide and the diverse processes taking place in thermal reduction of GO into reduced graphene oxide (RGO) are still not completely clear despite the sizable amount of studies concerning this issue[2].

TEM and EELS, using a sample holder capable of heating samples up to 1200°C within the TEM, is a unique and extensive technique for the analysis of the reduction of GO. Using this technique, we can measure, simultaneously and *in situ*, four main properties essential to this analysis at several intermediate temperatures and under high vacuum: the oxidation rate [3], its thickness [4], its mass density [5] and its sp²-sp³ bond ratio [6].

This study presents an analysis of GO by studying all of the aforementioned properties in two different studies: a first one heating up to 300°C to better understand the physisorbed and chemisorbed water desorption, and a second one up to 1200°C focused on the desorption of various oxygen functional groups; as well as the graphitisation of GO. Our results will be compared with previous studies on the matter.



References

1. Dreyer, D. R. The chemistry of graphene oxide.
2. K. P. Loh *et al*, Nat. Chem, 2(12), 1015–1024.
3. L. Grade & F. Javier, Advanced methods for Electron Energy Loss Spectroscopy core-loss analysis.
4. T. Malis *et al*, Journal of Electron Microscopy Technique, 8, 193-200
5. K. Gross *et al*, Nanotechnology 27(36), 1-10
6. L. Lajaunie *et al*, Carbon 112, 149-161
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